Wavelet Based on Satellite Image Resolution Enhancement

Aparna Gupta, Sonika Arora

Abstract— **Satellite images are being used in many fields of research. Satellite images are being used in many applications like Meteorology, Agriculture, Geology, Forestry, Landscape, Biodiversity, Planning, Instruction, Area and oceanography. The Image Enhancement is the main technique for improving the resolution and visual appearance of the image. One of the major issues in Image Enhancement is Wavelet Transform. The Wavelet Transform is the technique which decomposes an image into a set of basic functions called Wavelets. A new satellite image resolution enhancement technique based on the interpolation of the high-frequency sub-band images obtained by discrete wavelet transform (DWT) and the input image. DWT is applied in order to decompose an input image into dissimilar sub-bands. Then the high frequency sub-bands as well as the input image are interpolated. All these sub-bands are combined to generate a new high resolution image by using inverse DWT (IDWT). The quantitative peak signal-to-noise ratio (PSNR) and root mean square error (RMSE) and visual results show the superiority of the proposed technique over the conventional bicubic interpolation, wavelet zero padding and state-of-art image resolution enhancement techniques.**

Index Terms—**Discrete wavelet transform (DWT), Interpolation , Resolution Enhancement, Satellite Images,**

I. INTRODUCTION

Resolution of an image has been always an important issue in many image- and video processing applications, such as video resolution improvement, element removal and satellite image resolution enhancement. Interpolation in image processing is a technique to increase the number of pixels in a digital image. Interpolation has been generally used in many image processing applications, such as facial renovation, several report coding and image resolution enhancement. The interpolation-based picture resolution enhancement has been use for a long time and many interpolation techniques have been developed to increase the value of this task. There are three well- famous interpolation techniques, namely, nearest neighbour, bilinear and bicubic. Bicubic interpolation is less sophisticated than the other two techniques and produces smoother edges.

Wavelets are also playing a significant role in many image processing applications. The 2-D wavelet disintegration of an image is perform by applying the 1-D discrete wavelet transform (DWT) beside the rows of the image first, and then the results are decayed along the columns. This function results in four decomposed sub-band images referred to low low (LL), low-high (LH), high-low (HL), and high-high (HH). The frequency components of those sub-bands cover the full frequency spectrum of the original image. Theoretically, a filter bank shown in Fig.(a) should operate on the image in order to generate different sub-band frequency images.

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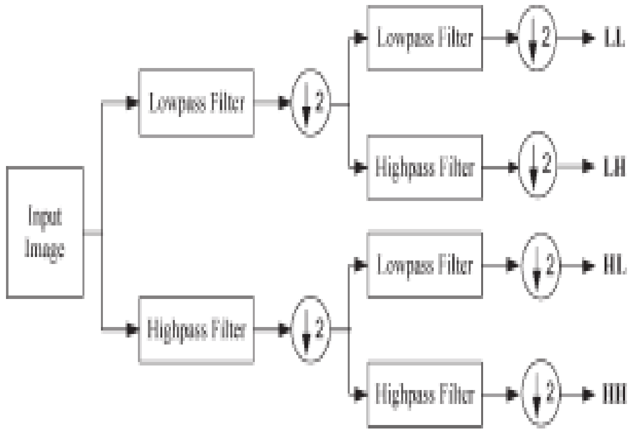

Fig.(a) Block diagram of DWT filter banks of level 1.

II. WAVELET-BASED IMAGE RESOLUTION ENHANCEMENT

A. SWT-Based Image Resolution Enhancement

Discrete Wavelet Transform (DWT), Stationary wavelet transform (SWT) and integer wavelet transform are three adaptable tools for current image processing. These techniques have different image processing applications such as super resolution, facial renovation, several description coding and video improvement . The SWT is an essentially redundant scheme as the output of each level of SWT contains the same number of samples as the input so for a decomposition of N levels there is a redundancy of N in the wavelet coefficients. The interpolate high frequency sub-bands and the SWT high frequency sub-bands have the same size which means they can be added with all other. The new correct high frequency sub-bands can be interpolated further for higher growth. Also it is known that in the wavelet domain, low pass filter of the high resolution picture produce the low resolution image. In new terms, low frequency sub-band is the low resolution of the new image. The interpolation of isolated high frequency components in high frequency sub-bands and using the correction obtain by adding up high frequency sub-bands of SWT of the input image, will conserve more high frequency apparatus after the interpolation than interpolating input.

B. CWT-Based Image Resolution Enhancement

In this technique, dual-tree CWT (DT-CWT) is used to decompose an input image into dissimilar sub-band images. DT-CWT is used to decompose an input low-resolution image into different sub-bands. In that case, the high-frequency sub-band images and the input image are interpolated, follow by combining all these images to produce a new high-resolution image by using inverse DT-CWT. The resolution improvement is achieved by using directional selectivity provide by the CWT, where the high-frequency sub-bands in six different directions contribute to the sharpness of the high-frequency detail, such as edges.

C. DWT-Based Image Resolution Enhancement

DWT has been employed in order to preserve the high-frequency apparatus of the image. DWT separate the image into dissimilar sub band images, explicitly, LL, LH, HL, and HH. High frequency sub-bands restrain the high-frequency component of the image. The interpolation can be apply to these four sub band images. In the wavelet field, the low-resolution image is obtained by low-pass filter of the high-resolution image. The low-resolution image (LL sub band), with no quantization (i.e., with double-precision pixel values) is used as the input for the proposed resolution enhancement process. In further words, low-frequency sub band images are the low resolution of the new image. Thus, in its place of using low-frequency sub band images, which include less information than the new input image, we are using this input image during the interpolation method. Thus, the input low-resolution image is interpolated with the half of the interpolation factor, α/2, use to interpolate the high-frequency sub bands, as shown in Fig.(b). In order to maintain more edge information, i.e., obtain a sharper enhanced image; we have planned an intermediate stage in high-frequency sub-band interpolation process.

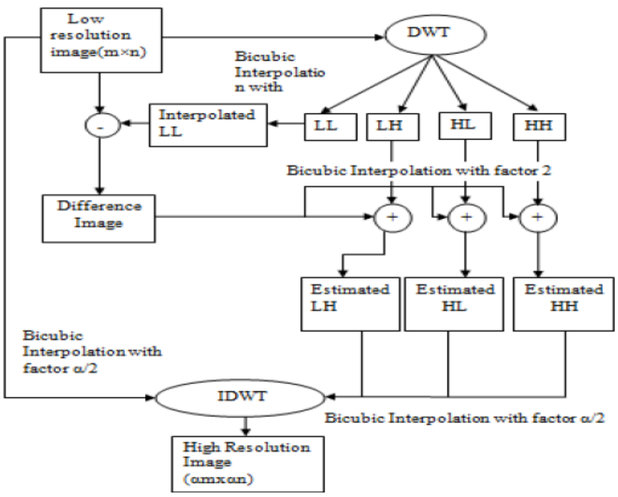

Fig.(b) DWT resolution enhancement algorithm.

III. RESULTS AND DISCUSSION

A. Result

The Literature survey is done. The proposed resolution enhancement method uses DWT to decompose the input image into dissimilar sub-band. Then, the high-frequency sub-band images and the input low-resolution image have been interpolated, follow by combining everyone these images to make a new resolution-enhanced image by using inverse DWT. In order to accomplish a sharper image, an intermediate stage (interpolation technique) has been used. In proposed technique, the implementation process is doing using MATLAB.

B. B. Discussion

Proposed method has been experienced with standard set of analysis images. The input images of resolution 128x128 are used, which are great resolved to 512x512. Due to the breathing space limitations viewing the results obtained with images. Original image along with high resolution images obtained by several super resolution techniques. PSNR is used as a value calculates.

IV. CONCLUSION

This paper has proposed a original resolution enhancement technique based on the interpolation of the high-frequency subband images obtained by DWT and the input image. The proposed method has been tested on well-known standard images, where their PSNR, RMSE and visual results show the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement technique. The PSNR enhancement of the proposed technique is up to 7.19 dB compare with the standard bi-cubic interpolation.

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